

**IN THE CLAIMS**

Please amend the claims as indicated:

- 1 1. (previously presented) An apparatus for use in a borehole for electrical imaging  
2 during rotary drilling comprising:  
3 (a) a resistivity sensor having an offset from a wall of the borehole that is  
4 greater than a specified minimum value;  
5 (b) an orientation sensor making a measurement of a toolface angle of said  
6 apparatus during continued rotation thereof; and  
7 (c) a device which maintains said resistivity sensor at said offset.  
8
- 1 2. (original) The apparatus of claim 1 wherein said resistivity sensor comprises a  
2 galvanic sensor.  
3
- 1 3. (previously presented) The apparatus of claim 1 wherein said resistivity sensor is  
2 mounted on a pad.  
3
- 1 4. (previously presented) The apparatus of claim 1 wherein said resistivity sensor is  
2 mounted on a rib.  
3
- 1 5. (previously presented) The apparatus of claim 1 wherein said resistivity sensor is  
2 mounted on a stabilizer.  
3

- 1 6. (previously presented) The apparatus of claim 1 wherein said resistivity sensor  
2 further comprises
- 3 (i) a current electrode which conveys a measure current into said formation  
4 through a conducting fluid, and
- 5 (ii) at least one guard electrode proximate to said current electrode for  
6 maintaining focusing of said measure current.  
7
- 1 7. (original) The apparatus of claim 6 wherein said at least one guard electrode  
2 focuses said measure current in a direction substantially normal to said borehole  
3 wall.  
4
- 1 8. (original) The apparatus of claim 7 wherein said at least one guard electrode  
2 surrounds said measure electrode and maintains a focusing of said measure  
3 current in a flushed zone of said formation.  
4
- 1 9. (original) The apparatus of claim 7 wherein the at least one guard electrode  
2 comprises a plurality of guard electrodes for altering a depth of investigation of  
3 said resistivity sensor.  
4
- 1 10. (original) The apparatus of claim 6 wherein said at least one guard electrode  
2 comprises a plurality of guard electrodes that create substantially spherical  
3 equipotential surfaces

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1 11. (previously presented) The apparatus of claim 1 wherein said resistivity sensor  
2 further comprises:

3 (i) a current electrode which conveys a measure current into said formation,  
4 and

5 (ii) a measure electrode spaced apart from said current electrode,  
6 the apparatus further comprising a processor which determines from a voltage of  
7 said measure electrode and said measure current an indication of a resistivity of  
8 said earth formation.

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1 12. (original) The apparatus of claim 8 further comprising monitor electrodes to  
2 support the focusing in the presence of non negligible contact impedances.

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1 13. (original) he apparatus of claim 9 further comprising monitor electrodes to  
2 support the focusing in the presence of non negligible contact impedances.

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1 14. (original) The apparatus of claim 8 wherein further comprising a pad that  
2 substantially circumscribes said apparatus, said pad carrying said sensor thereon

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1 15. (original) The apparatus of claim 14 further comprising monitor electrodes to  
2 support the focusing in the presence of non negligible contact impedances.

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- 1 16. (previously presented) The apparatus of claim 8 further comprising a controller  
2 which maintains a substantially constant power consumption by said  
3 electrodes.  
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- 1 17. (previously presented) The apparatus of claim 12 further comprising a controller  
2 which maintains a substantially constant power consumption by said electrodes.  
3
- 1 18. (previously presented) The apparatus of claim 14 further comprising a controller  
2 which maintains a substantially constant power consumption by said electrodes.  
3
- 1 19. (previously presented) The apparatus of claim 14 further comprising a controller  
2 which maintains a substantially constant power consumption by said electrodes.  
3
- 1 20. (original) The apparatus of claim 1 wherein said orientation sensor comprises a  
2 magnetometer.  
3
- 1 21. (original) The apparatus of claim 1 wherein said orientation sensor comprises an  
2 accelerometer.  
3
- 1 22. (original) The apparatus of claim 1 wherein said device comprises a stabilizer.  
2
- 1 23. (original) The apparatus of claim 1 wherein said device comprises a steerable rib.

2

1 24. (original) The apparatus of claim 1 wherein said borehole is filled with a  
2 substantially nonconducting fluid and wherein said resistivity sensor is  
3 capacitively coupled to said earth formation.

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1 25. (original) The apparatus of claim 24 wherein said resistivity sensor makes  
2 measurements at a plurality of different frequencies.

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1 26. (original) The apparatus of claim 1 wherein said borehole includes a substantially  
2 non-conducting fluid therein.

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1 27. (previously presented)The apparatus of claim 2 wherein said borehole includes a  
2 substantially non-conducting fluid therein and wherein said resistivity sensor  
3 conveys a measure current into said formation using capacitive coupling.

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1 28. (original) The apparatus of claim 1 wherein said resistivity sensor further  
2 comprises a shielded dipole.

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1 29. (original) The apparatus of claim 26 wherein said resistivity sensor further  
2 comprises a shielded dipole.

3

1 30. (original) The apparatus of claim 26 wherein said resistivity sensor further

2 comprises a directionally sensitive induction logging tool.

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1 31. (original) The apparatus of claim 30 wherein said directionally sensitive induction  
2 logging tool comprises a quadrupole transmitter.

3

1 32. (original) The apparatus of claim 26 wherein said resistivity sensor further  
2 comprises a radio frequency microwave transmitter

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1 33. (original) The apparatus of claim 26 wherein said resistivity sensor comprises an  
2 induction coil.

3

1 34 (withdrawn) A system for use in a borehole for determining a resistivity  
2 parameter during drilling of a borehole in an earth formation comprising:

- 3 (a) a bottom hole assembly (BHA) including
- 4 (i) a resistivity subassembly having a resistivity sensor with an offset
- 5 from a wall of the borehole that is greater than a specified
- 6 minimum value during rotation of the BHA;
- 7 (ii) an orientation sensor on said subassembly which makes a
- 8 measurement of a toolface angle of said subassembly during
- 9 continued rotation thereof; and
- 10 (ii) a device which maintains said resistivity sensor at said offset.
- 11 (b) a processor which determines said resistivity parameter from

12 measurements made by said resistivity sensor;

13 (c) a device which drills said borehole; and

14 (d) conveyance device which conveys said BHA into said borehole.

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1 35. (withdrawn) The system of claim 34 wherein said device for drilling said borehole  
2 comprises a drill bit.

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1 36. (withdrawn) The system of claim 34 wherein said conveyance device comprises  
2 a drill string.

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1 37. (withdrawn) The system of claim 34 wherein said processor is part of said BHA.

2

1 38. (withdrawn) The system of claim 34 wherein said processor includes a  
2 memory device which stores at least a subset of measurements made by said  
3 resistivity sensor.

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1 39. (withdrawn) The system of claim 34 wherein said resistivity sensor comprises a  
2 galvanic sensor.

3

1 40. (withdrawn) The system of claim 39 wherein said sensor further comprises  
2 (i) a current electrode which conveys a measure current into said formation  
3 through a conducting fluid, and

- 4 (ii) at least one guard electrode proximate to said current electrode which  
5 maintains focusing of said measure current.  
6

1 41. (withdrawn) The system of claim 40 wherein said processor maintains a  
2 substantially constant power consumption by said electrodes.  
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1 42. (withdrawn) The system of claim 34 wherein said orientation sensor comprises a  
2 magnetometer.  
3

1 43. (withdrawn) The system of claim 34 wherein said orientation sensor comprises an  
2 accelerometer.  
3

1 44. (withdrawn) The system of claim 34 wherein said device comprises a stabilizer.  
2

1 45. (withdrawn) The system of claim 34 wherein said device comprises a steerable  
2 rib.  
3

1 46. (withdrawn) The system of claim 34 wherein said borehole is filled with a  
2 substantially nonconducting fluid and wherein said resistivity sensor is  
3 capacitively coupled to said earth formation.  
4

1 47. (withdrawn) The system of claim 46 wherein said resistivity sensor makes



2 measurements at a plurality of different frequencies.

3

1 48. (withdrawn) The system of claim 34 wherein said borehole includes a  
2 substantially non-conducting fluid therein and wherein said resistivity sensor  
3 conveys a measure current into said formation using capacitive coupling.

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1 49. (withdrawn) The system of claim 34 wherein said resistivity sensor further  
2 comprises a shielded dipole.

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1 50. (withdrawn) The system of claim 34 wherein said resistivity sensor further  
2 comprises a directionally sensitive induction logging tool.

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1 51. (withdrawn) The system of claim 50 wherein said directionally sensitive induction  
2 logging tool comprises a quadrupole transmitter.

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1 52. (withdrawn) The system of claim 34 wherein said resistivity sensor further  
2 comprises a radio frequency microwave transmitter

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1 53. (withdrawn) The system of claim 34 wherein said resistivity parameter comprises  
2 a resistivity image of said borehole.

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1 54. (withdrawn) A method of determining a parameter of an earth formation during

- 2 formation of a borehole in said earth formation by a device on a bottom hole  
3 assembly (BHA), the method comprising:
- 4 (a) maintaining a resistivity sensor on said BHA substantially at an offset  
5 from a wall of the borehole less than a specified minimum value;
  - 6 (b) using said resistivity sensor for making measurements indicative of said  
7 parameter during continued rotation of said BHA;
  - 8 (c) using an orientation sensor on said BHA for making a measurement of a  
9 toolface angle of said BHA during said continued rotation; and
  - 10 (d) using a processor for determining from said measurements said parameter

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- 1 55. (withdrawn) The method of claim 54 wherein said resistivity sensor comprises a  
2 galvanic sensor.

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- 1 56. (withdrawn) The method of claim 54 further comprising mounting said resistivity  
2 sensor on a pad.

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- 1 57. (withdrawn) The method of claim 54 further comprising mounting said resistivity  
2 sensor on a rib of said BHA.

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- 1 58. (withdrawn) The method of claim 54 further comprising mounting said resistivity  
2 sensor on a stabilizer of said BHA.

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- 1 59. (withdrawn) The method of claim 54 further comprising  
2 (i) using a current electrode of said resistivity sensor for conveying a measure  
3 current into said formation through a conducting fluid, and  
4 (ii) using at least one guard electrode proximate to said current electrode for  
5 maintaining focusing of said measure current.  
6
- 1 60. (withdrawn) The method of claim 59 further comprising using said at least one  
2 guard electrode for focusing said measure current in a direction substantially  
3 normal to a borehole wall.  
4
- 1 61. (withdrawn) The method of claim 60 wherein said at least one guard electrode  
2 surrounds said measure electrode and maintains a focusing of said measure  
3 current in a flushed zone of said formation.  
4
- 1 62. (withdrawn) The method of claim 59 further comprising using said at least one  
2 guard electrode for creating substantially spherical equipotential surfaces  
3
- 1 63. (withdrawn) The method of claim 54 further comprising:  
2 (i) using a current electrode of said resistivity sensor for conveying a measure  
3 current into said formation,  
4 (ii) measuring a voltage of a measure electrode spaced apart from said current  
5 electrode; and

6 (iii) using said processor for determining from a voltage of said measure  
7 electrode and said measure current said resistivity parameter.  
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1 64. (withdrawn) The method of claim 60 further comprising using monitor electrodes  
2 to support the focusing in the presence of non negligible contact impedances.  
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1 65. (withdrawn) The method of claim 61 further comprising using monitor electrodes  
2 to support the focusing in the presence of non negligible contact impedances.  
3

1 66. (withdrawn) The method of claim 60 further comprising carrying said sensor on a  
2 pad that substantially circumscribes said apparatus.  
3

1 67. (withdrawn) The method of claim 66 further comprising using monitor electrodes  
2 to support the focusing in the presence of non negligible contact impedances.  
3

1 68. (withdrawn) The method of claim 60 further comprising using a processor for  
2 maintaining a substantially constant power consumption by said electrodes.  
3

1 69. (withdrawn) The method of claim 64 further comprising using a processor for  
2 maintaining a substantially constant power consumption by said electrodes.  
3

1 70. (withdrawn) The method of claim 66 further comprising using a processor for

2 maintaining a substantially constant power consumption by said electrodes.

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1 71. (withdrawn) The method of claim 67 further comprising using a processor for  
2 maintaining a substantially constant power consumption by said electrodes.

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1 72. (withdrawn) The method of claim 54 wherein said orientation sensor comprises a  
2 magnetometer.

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1 73. (withdrawn) The method of claim 54 wherein said orientation sensor comprises  
2 an accelerometer.

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1 74. (withdrawn) The method of claim 54 further comprising using a stabilizer for  
2 maintaining said specified offset.

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1 75. (withdrawn) The method of claim 54 further comprising using a steerable rib for  
2 maintaining said specified offset.

3

1 76. (withdrawn) The method of claim 54 further comprising:

2 (i) using said BHA in a borehole is filled with a substantially nonconducting  
3 fluid, and

4 (ii) capacitively coupling said resistivity sensor to said earth formation.

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- 1 77. (withdrawn) The method of claim 76 further comprising using said resistivity  
2 sensor for making measurements at a plurality of different frequencies.  
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- 1 78. (withdrawn) The method of claim 76 further comprising using said resistivity  
2 sensor for making measurements at two frequencies.  
3
- 1 79. (withdrawn) The method of claim 77 further comprising using said processor for  
2 performing a multi-frequency focusing of said measurements.  
3
- 1 80. (withdrawn) The method of claim 54 wherein said borehole includes a  
2 substantially non-conducting fluid therein.  
3
- 1 81. (withdrawn) The method of claim 55 further comprising:  
2 (i) using said BHA in a borehole is filled with a substantially nonconducting  
3 fluid, and  
4 (ii) capacitively coupling said resistivity sensor to said earth formation  
5
- 1 82. (withdrawn) The method of claim 54 wherein said resistivity sensor further  
2 comprises a shielded dipole.  
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- 1 83. (withdrawn) The method of claim 80 wherein said resistivity sensor further  
2 comprises a shielded dipole.

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1 84. (withdrawn) The method of claim 80 wherein said resistivity sensor further  
2 comprises a directionally sensitive induction logging tool.

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1 85. (withdrawn) The method of claim 84 wherein said directionally sensitive  
2 induction logging tool comprises a quadrupole transmitter.

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1 86. (withdrawn) The method of claim 80 wherein said resistivity sensor further  
2 comprises a radio frequency microwave transmitter.

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1 87. (withdrawn) The method of claim 54 further comprising using an induction coil as  
2 said resistivity sensor.

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1 88. (withdrawn) The method of claim 87 further comprising using said processor for  
2 determining an inductance of said induction coil.

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1 89. (withdrawn) The method of claim 86 further comprising using said processor for  
2 determining an extent of a fluid invasion of the earth formation.

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1 90. (withdrawn) The method of claim 54 wherein said orientation sensor comprises a  
2 magnetometer

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1 91. (new) The apparatus of claim 1 further comprising a bottomhole assembly (BHA)  
2 carrying the resistivity sensor into the borehole.

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1 92. (new) The apparatus of claim 1 further comprising a conveyance device which  
2 conveys the resistivity sensor into the borehole.

3

1 93. (new) The apparatus of claim 91 further comprising an orientation sensor that  
2 makes measurements of an orientation of the BHA during continued rotation  
3 thereof.

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